Statistics: The Science of Decisions Project Instructions

Background Information

In a Stroop task, participants are presented with a list of words, with each word displayed in a color of ink. The participant's task is to say out loud the color of the ink in which the word is printed. The task has two conditions: a congruent words condition, and an incongruent words condition. In the congruent words condition, the words being displayed are color words whose names match the colors in which they are printed: for example RED, BLUE. In the incongruent words condition, the words displayed are color words whose names do not match the colors in which they are printed: for example PURPLE, ORANGE. In each case, we measure the time it takes to name the ink colors in equally-sized lists. Each participant will go through and record a time from each condition.

Questions For Investigation

As a general note, be sure to keep a record of any resources that you use or refer to in the creation of your project. You will need to report your sources as part of the project submission.

1. What is our independent variable? What is our dependent variable?

The word/color congruency (congruency between the word color and its ink color) is the independent variable. Reading time in seconds (the time spent to read all words correctly) is the dependent variable.

2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.

In this case, we will test hypotheses to find evidence if the change in sample infer the population change or by chance . We decided that The word/color congruency has no effect on the mean of population reading time as a null hypothesis. The congruent population means (μ_C) will be equal to the incongruent population means (μ_I).

$$H_0 : \mu_I = \mu_C$$

The alternative hypothesis is The low of word/color congruency in incongruent task will increase the mean of population reading time. The incongruent population means(μ_I) will

be greater than the congruent population means (μ_C). We use directional hypothesis which increase power to detect the word/color congruency effect.

$$H_a : \mu_I > \mu_C$$

We have one small sample contain 24 participants. In our case, T-Test is more applicable to hypothesis testing than z-Test because we don't know what is the population standard deviation. We assume that the distributed according to a Gaussian distribution.

We choose Dependent-Samples t Test (paired t-test) because one sample has been tested twice and we measure the difference between the two results. Based on the directional alternative hypothesis, we will use the one tailed t-test in a positive direction. It measure if the difference between two means is greater than the critical value.

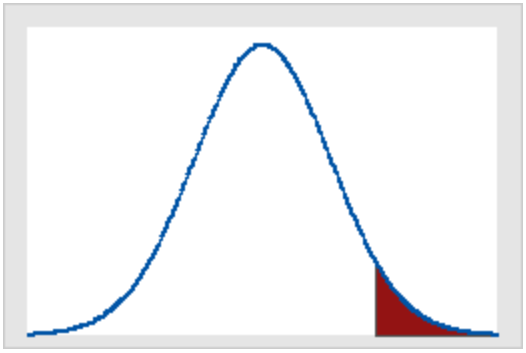

Figure 1 critical region in one tailed t-test in a positive direction

3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

The mean of participants in congruent task is 14.05 seconds and for incongruent task is 22.02 seconds. The variance between tow means is 7.96 seconds. The standard deviation for congruent task is 3.56 and for incongruent task is 4.80. This means incongruent task has wide distributed results than congruent task. I get 17.22 seconds in congruent task and 27.9 seconds in incongruent task which is above the average.

4. Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

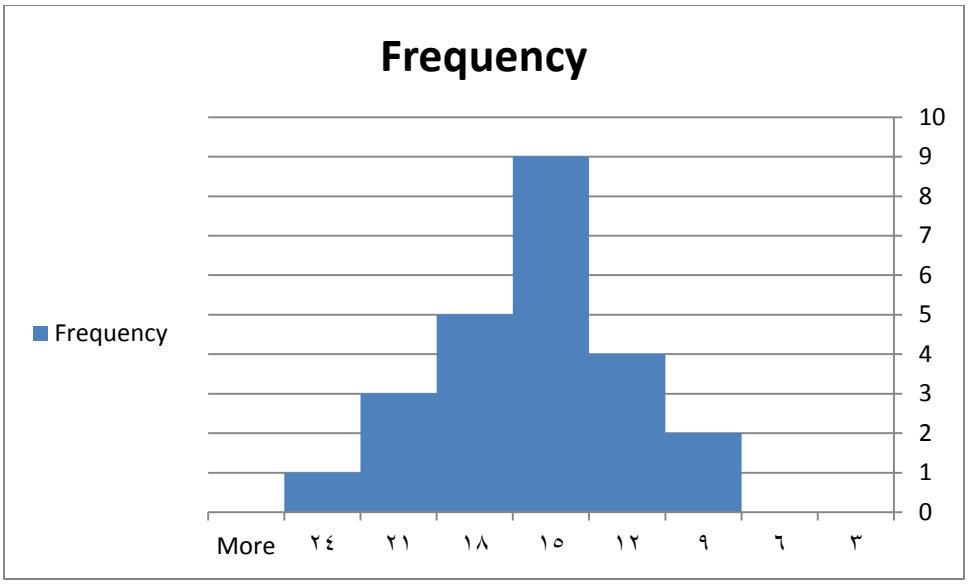

Figure 2 the Histogram for congruent task

The diagram above is the histogram for congruent task. The x-axis present the bin size (which is 3) and frequency at y-axis. The diagram is normally distributed which mean the sample is randomly selected and do not have out liar.

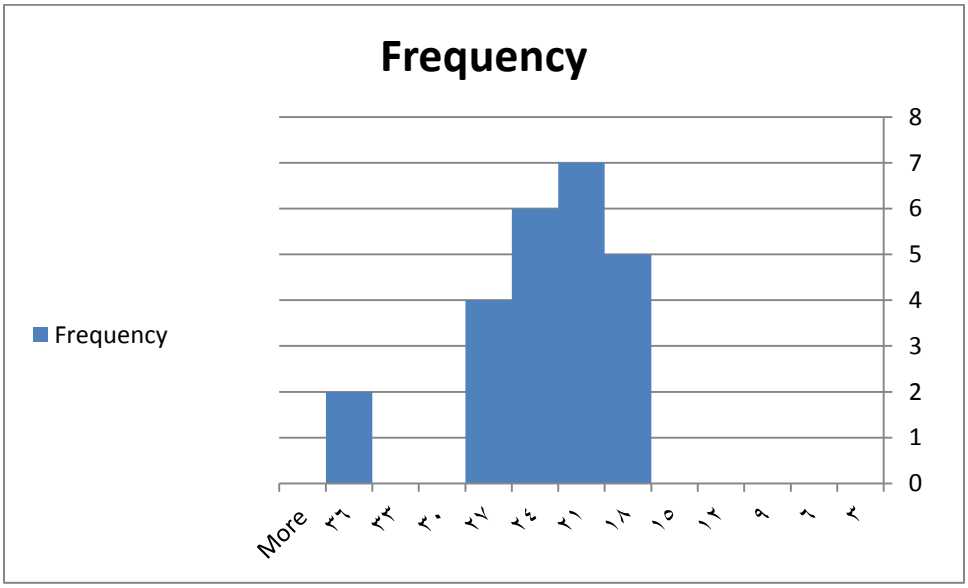

Figure 3 Histogram for incongruent task

The diagram above is the histogram for incongruent task. We can notice that the mean shifted to the twenties an there are two values far away from other values.

5. Now, perform the statistical test and report your results. What is your confidence level and your critical statistic value? Do you reject the null hypothesis or fail to reject it? Come to a conclusion in terms of the experiment task. Did the results match up with your expectations?

We perform one tailed dependent-samples t Test with $\alpha <= .05$ to test the hypothesis. The confidence level is 95% .

Table 1 t-Test: Paired Two Sample for Means

	Congruent	*Incongruent*
Mean	14.051125	22.01591667
Variance	12.66902907	23.01175704
Observations	24	24
Pearson Correlation	0.351819527	
Hypothesized Mean Difference	0	
df	23	
t Stat	-8.020706944	
P(T<=t) one-tail	2.0515E-08	
t Critical one-tail	1.713871528	

In the table above, we see that positive *t Stat* is bigger than the critical value *8.02>1.71* and the *p* value is less than .05. Then, these results is statistically significant and we reject the null.

$$t(23)=8.02,\ p= 0.0001,\ one\ tiled$$

We conclude with The low of word/color congruency in incongruent task will increase the mean of participants' reading time and $r= 0.74$ which tells us that the 74% difference between two task result of the sample is due the low of word/color congruency.

6. Optional: What do you think is responsible for the effects observed? Can you think of an alternative or similar task that would result in a similar effect? Some research about the problem will be helpful for thinking about these two questions!

Reference:

http://www.graphpad.com/quickcalcs/pValue2/